

# What Works Clearinghouse



Early Childhood Education

September 2008

## Tools of the Mind

### Program description<sup>1</sup>

*Tools of the Mind* is an early childhood curriculum for preschool and kindergarten children, based on the ideas of Russian psychologist Lev Vygotsky. The curriculum is designed to foster

children's executive function, which involves developing self-regulation, working memory, and cognitive flexibility. Many activities emphasize both executive functioning and academic skills.

### Research

One study of *Tools of the Mind* meets the What Works Clearinghouse (WWC) evidence standards. The study included more than 200 three- to four-year-old children attending preschool in a low-income, urban school district.<sup>2</sup> The WWC considers the extent of

evidence for *Tools of the Mind* to be small for oral language, print knowledge, cognition, and math. No studies that meet the WWC evidence standards with or without reservations addressed phonological processing or early reading/writing.

### Effectiveness

*Tools of the Mind* was found to have no discernible effects on oral language, print knowledge, cognition, and math.

	Oral Language	Print knowledge	Cognition	Math	Phonological processing	Early reading/writing
<b>Rating of effectiveness</b>	No discernible effects	No discernible effects	No discernible effects	No discernible effects	na	na
<b>Improvement index<sup>3</sup></b>	Average: +6 percentile points	Average: 0 percentile points	+2 percentile points	+7 percentile points	na	na
	Range: +4 to +8 percentile points	Range: -1 to +1 percentile points	na	na	na	na

na = not applicable

1. The descriptive information for this program was obtained from publicly available sources: the program website ([http://www.mscedu.org/extendedcampus/tools\\_ofthemind/index.shtml](http://www.mscedu.org/extendedcampus/tools_ofthemind/index.shtml), retrieved July 2008) and the literature reviewed for this report. The WWC asks developers to review the program description sections for accuracy from their perspective. Further verification of the accuracy of the descriptive information for this program is beyond the scope of this review.
2. The study was conducted in one school, with a full-day Abbott preschool education program, in which both the intervention and comparison group children participated. The evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available.
3. These numbers show the average and range of student-level improvement indices for all findings across the study. For cognition and math, the improvement index is based on a single finding.

## Additional program information

### Developer and contact

Developed by Deborah J. Leong and Elena Bodrova, *Tools of the Mind* is distributed by Metropolitan State College of Denver, Center for Improving Early Learning. Address: 5660 Greenwood Plaza Blvd., Suite 100, Greenwood Village, CO 80111. Email: [leongd@mscd.edu](mailto:leongd@mscd.edu). Web: <http://www.mscd.edu/extendedcampus/toolsofthemind/index.shtml>. Telephone: (303) 721-1313.

### Scope of use

*Tools of the Mind* was first implemented in preschool classrooms in 1993. During the 2008/09 school year *Tools of the Mind* will be active in more than 450 full- and half-day classrooms in Colorado, Maine, Massachusetts, New Jersey, New Mexico, and Oregon. *Tools of the Mind* is used in Head Start centers, public preschool programs, and child care centers in various settings. The curriculum is appropriate for use with typically developing children, as well as English language learners, and has been used in both inclusion and special education classrooms.

### Teaching

*Tools of the Mind* can be implemented in a variety of early childhood settings. The curriculum focuses on 40 activities designed to develop children's executive function, including child-directed, teacher-supported, and cooperative peer activities. Instruction is individualized through teacher scaffolding. Dramatic play is a main component of the curriculum. With intentional planning by the children and support from the teacher, this component exposes children to a range of experiences that foster self-regulation skills. For example, children are encouraged to write or draw a representation of their plan for a pretend play activity. Self-regulation is viewed as a necessary prerequisite to school readiness and is embedded in activities throughout the day.

Thus, activities are designed for children to simultaneously practice self-regulation and cognitive skills, such as "Buddy Reading," during which children explore concepts of print but also practice staying in the role of "reader" and "listener." Professional development for teachers, paraprofessionals, and program coaches are provided by *Tools of the Mind* staff during the first two years of implementation. In the first year the trainers offer four workshops and conduct at least four site visits, depending on the program's size. The program coaches receive specialized training, a coaching manual, pacing guides, and a fidelity checklist.

### Cost

*Tools of the Mind* is typically implemented over a two-year period. During this time the developer provides intensive professional development to facilitate implementation. The first year of implementation costs about \$3,000 per classroom, excluding travel and depending on the program's size. The price includes training for most staff that work with the students, such as paraprofessionals and supervisors—although special education staff are trained separately at additional cost. The cost and number of site visits provided vary depending on the number of classrooms in the program. The curriculum guides cost an additional \$100. The developer and adopters negotiate the cost of the second year of professional development services, typically about \$1,500. Although the developers of *Tools of the Mind* do not sell classroom materials, they provide a list of recommended materials that programs can purchase from other vendors.

**Research** Four studies reviewed by the WWC investigated the effects of *Tools of the Mind* on preschool children's cognitive and language competencies and their school readiness. One study (Barnett et al., 2008) was a randomized controlled trial that meets WWC evidence standards. The remaining three studies did not meet WWC evidence standards.

Seven other studies did not meet WWC eligibility screens. Five did not investigate the effects of *Tools of the Mind* on children's outcomes, one did not focus on preschool-age children, and one did not provide enough information to assess its study design.

Barnett et al. (2008) conducted a randomized controlled trial of teachers and students to investigate the effects of the program. In an urban school, teachers and their assistants were randomly assigned to classrooms using a stratified random assignment procedure. Three- to four-year-old children attending preschools were then randomly assigned to either *Tools of the Mind* or comparison group classrooms. In all, 85 children in 7 classrooms used *Tools of the Mind*, and 117 children in the 11 comparison group classrooms used their regular district

curriculum. According to the study authors, the district curriculum covered much of the same academic content and topics as *Tools of the Mind*, but there was greater emphasis on teacher-imposed control and less on children's self-regulation. The study reported students' outcomes after the first year of program implementation.

### Extent of evidence

The WWC categorizes the extent of evidence in each domain as small or medium to large (see the [What Works Clearinghouse Extent of Evidence Categorization Scheme](#)). The extent of evidence takes into account the number of studies and the total sample size across the studies that meet WWC evidence standards with or without reservations.<sup>4</sup>

The WWC considers the extent of evidence for *Tools of the Mind* to be small for oral language, print knowledge, cognition, and math. No studies that meet the WWC evidence standards with or without reservations addressed phonological processing or early reading/writing.

## Effectiveness Findings

The WWC review of interventions for Early Childhood Education addresses student outcomes in six domains: oral language, print knowledge, cognition, math, phonological processing, and early reading/writing. The study included in this report covers four domains: oral language, print knowledge, cognition, and math. The findings below present the authors' estimates and WWC-calculated estimates of the size and statistical significance of the effects of *Tools of the Mind* on children.<sup>5</sup>

*Oral language.* Barnett et al. (2008) reported results separately for regression and hierarchical linear model (HLM) analyses. For regression analysis, the authors found a statistically significant positive effect of *Tools of the Mind* on the Peabody Picture Vocabulary Test (PPVT-III). For hierarchical linear model analysis, which accounted for clustering of children within classrooms, the effect was not statistically significant. The study authors did not find statistically significant effects of *Tools of the Mind* on the second oral language measure: Expressive One-Word Picture

4. The Extent of Evidence Categorization was developed to tell readers how much evidence was used to determine the intervention rating, focusing on the number and size of studies. Additional factors associated with a related concept, external validity, such as the students' demographics and the types of settings in which studies took place, are not taken into account for the categorization. Information about how the extent of evidence rating was determined for *Tools of the Mind* is in Appendix A6.
5. The level of statistical significance was reported by the study authors or, where necessary, calculated by the WWC to correct for clustering within classrooms or schools and for multiple comparisons. For an explanation, see the [WWC Tutorial on Mismatch](#). For the formulas the WWC used to calculate the statistical significance, see [Technical Details of WWC-Conducted Computations](#). For the *Tools of the Mind* study summarized here, no corrections for clustering and multiple comparisons were needed.

## Effectiveness *(continued)*

Vocabulary Test-Revised (EOWPVT-R). The WWC found that the average effect size across the two outcomes was neither statistically significant nor large enough to be considered substantively important (an effect size at least 0.25) according to WWC criteria.

*Print knowledge.* The study authors did not find statistically significant effects of *Tools of the Mind* on either measure of print knowledge: Woodcock-Johnson-Revised Letter-Word Identification subtest or Get Ready to Read! assessment. The average effect size across the two outcomes was not large enough to be considered substantively important according to WWC criteria.

*Cognition.* Barnett et al. (2008) did not find a statistically significant effect of the *Tools of the Mind* curriculum on the Animal Pegs Subtest of the Wechsler Preschool Primary Scale of Intelligence, and the effect was not large enough to be considered substantively important according to WWC criteria.

*Math.* Barnett et al. (2008) did not find a statistically significant effect of the *Tools of the Mind* curriculum on the Woodcock-Johnson-Revised Applied Problems subtest, and the effect was not large enough to be considered substantively important according to WWC criteria.

## Rating of effectiveness

The WWC rates the effects of an intervention in a given outcome domain as positive, potentially positive, mixed, no discernible effects, potentially negative, or negative. The rating of effectiveness takes into account four factors: the quality of the research design, the statistical significance of the findings, the size of the difference between participants in the intervention and the comparison conditions, and the consistency in findings across studies (see the [WWC Intervention Rating Scheme](#)).

**The WWC found *Tools of the Mind* to have no discernible effects for oral language, print knowledge, cognition, or math.**

## Improvement index

The WWC computes an improvement index for each individual finding. In addition, within each outcome domain, the WWC computes an average improvement index for each study and an average improvement index across studies (see [Technical Details of WWC-Conducted Computations](#)). The improvement index represents the difference between the percentile rank of the average student in the intervention condition versus the percentile rank of the average student in the comparison condition. Unlike the rating of effectiveness, the improvement index is based entirely on the size of the effect, regardless of the statistical significance of the effect, the study design, or the analyses. The improvement index can take on values between -50 and +50, with positive numbers denoting results favorable to the intervention group.

The average improvement index for oral language is +6 percentile points in the one study, with a range of +4 to +8

percentile points across findings. The average improvement index for print knowledge is 0 percentile points in the one study, with a range of -1 to +1 percentile points across findings. The improvement index for cognition is +2 percentile points for a single finding of the study. The improvement index for math is +7 percentile points for a single finding of the study.

## Summary

The WWC reviewed four studies on *Tools of the Mind*. One study meets WWC evidence standards and three studies did not meet WWC evidence standards; seven other studies did not meet eligibility screens. Based on the one study, the WWC found no discernible effects in oral language, print knowledge, cognition, or math. The evidence presented in this report may change as new research emerges.

## References

### Meets WWC evidence standards

Barnett, W., Jung, K., Yarosz, D., Thomas, J., Hornbeck, A., Stechuk, R., & Burns, S. (2008). Educational effects of the *Tools of the Mind* Curriculum: a randomized trial. *Early Childhood Research Quarterly*, 23(3), 299–313.

### Did not meet WWC evidence standards

Bodrova, E., & Leong, D. J. (2002). *Tools of the Mind* research project: implementation of Vygotskian principles of development and learning in an early childhood literacy program. [Unpublished manuscript]. Denver, CO: Mid-continent Research for Education and Learning. This study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Bodrova, E., Leong, D. J., & Semenov, D. (1997). *Tools of the Mind end of the year report*. Denver, CO: Metropolitan State College of Denver, ECE project. This study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Diamond, A., Barnett, S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science*, 318(30), 1387–1388. This study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

### Did not meet WWC eligibility screens for *Tools of the Mind*

Bodrova, E., & Leong, D. J. (2001). *Tools of the Mind: a case study of implementing the Vygotskian approach in American early childhood and primary classrooms* (Innodata monographs 7). Geneva: International Bureau of Education. Retrieved from <http://www.ibe.unesco.org>. The study is ineligible for review because it does not provide enough information to assess whether it meets standards.

Bodrova, E., Leong, D. J., & Semenov, D. (1997). *Tools of the Mind end of the year report*, Adams School District 50. Denver, CO: Metropolitan State College of Denver. The study is ineligible for review because it does not use a sample within the age or grade range specified in the protocol.

Copple, C. (2003). Fostering young children's representation, planning, and reflection: a focus in three current early childhood models. *Journal of Applied Developmental Psychology*, 24(6), 763. This study is ineligible for review because it does not examine the effectiveness of an intervention.

Grigorenko, E. L. (1998). Mastering tools of the mind in school (trying out Vygotsky's ideas in classrooms). In R. J. Sternberg, & W. M. Williams (Eds.), *Intelligence, Instruction, and Assessment: Theory into Practice* (pp. 201–231). Mahwah, NJ: Lawrence Erlbaum Associates. This study is ineligible for review because it does not examine the effectiveness of an intervention.

Hyson, M. (2008). *Enthusiastic and engaged learners: approaches to learning in the Early Childhood Classroom*. New York: Teacher College Press and Washington, DC: NAEYC. This study is ineligible for review because it does not examine the effectiveness of an intervention.

Hyson, M., Copple, C., & Jones, J. (2006). Early childhood development and education. In K. A. Renninger, I. E. Sigel, W. Damon, & R. M. Lerner (Eds.), *Handbook of child psychology: Vol. 4. Child psychology in practice* (pp. 3–47). Hoboken, NJ: John Wiley & Sons, Inc. This study is ineligible for review because it does not examine the effectiveness of an intervention.

Zigler, E. F., & Bishop-Josef, S. J. (1996). The cognitive child vs. the whole child: lessons from 40 years of Head Start. In D. G. Singer, R. Golinkoff, & K. Hirsh-Pasek (Eds.), *Play = learning: how play motivates and enhances children's cognitive and social-emotional growth*. New York: Oxford University Press. This study is ineligible for review because it does not examine the effectiveness of an intervention.

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**For more information about specific studies and WWC calculations, please see the [WWC Tools of the Mind Technical Appendices](#).**